Peri-implant tissue management after immediate implant placement using a customized healing abutment

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Abstract: OBJECTIVE The unavoidable extraction of teeth in the esthetic area can be overcome through different treatment modalities. Recently, immediate implants appeared as a minimally invasive approach to resolving these cases; however, immediate implant loading is not always possible or indicated. In these cases, an innovative approach through customized healing abutments could be used to preserve the soft tissue contour, eliminating the need for reopening surgery and the use of provisional restorations to condition the mucosal contour. CLINICAL CONSIDERATIONS The present cases describe a simplified chairside approach to use customized healing abutments for immediate implants placed after tooth extraction in the anterior and posterior areas in order to maintain the soft tissue contours while reducing the clinical steps until delivering the final restorations. CONCLUSIONS This technique seems to be effective to guide the soft tissue healing around dental implants allowing a natural emergence profile with implant-supported restorations, reducing the number of treatment steps. CLINICAL SIGNIFICANCE The use of customized healing abutments prepares soft tissue for the prosthetic stage preserving its contours and eliminating the need for reopening surgery.

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Objective

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Clinical Considerations

The present cases describe a simplified chairside approach to use customized healing abutments for immediate implants placed after tooth extraction in the anterior and posterior areas in order to maintain the soft tissue contours while reducing the clinical steps until delivering the final restorations.

Conclusion

This technique seems to be effective to guide the soft tissue healing around dental implants allowing a natural emergence profile with implant-supported restorations, reducing the number of treatment steps.

Clinical Significance

The use of customized healing abutments prepares soft tissue for the prosthetic stage preserving its contours and eliminating the need for reopening surgery.

Key words: Customized healing abutment, immediate placement, soft tissue management, emergence profile.

Introduction

Physiological events such as imminent loss of the periodontal ligament and the resorption of the codependent bundle bone may occur after tooth extraction.[1] These events may lead to morphological, structural and compositional changes that may result in reduction of the volume of surrounding soft and hard tissues.[2,3] The resorption process varies greatly among patients and may be affected by patient-related and surgery-related factors, such as soft tissue thickness,[4,5] implant position,[6] location of the implant abutment-interface,[7,8] trauma during the extraction of teeth,[6,9] and others. Nowadays, different clinical approaches have been proposed with the purpose of minimizing the problem described above, and there has been a growing demand for less invasive procedures that allow a favorable prognosis, resulting in more esthetic and functional implant-supported prostheses.[10]

Minimally invasive tooth extraction, avoiding flap release,[11] followed by immediate implant placement and provisional restoration have been considered appropriate treatment for maintaining the architecture of hard and soft tissues, as well as avoiding a second surgical stage.[12,13] After obtaining secondary implant stability, the final prosthesis can be manufactured by copying the maintained soft tissue contours, thus guaranteeing more predictable results and simplifying the next stages of treatment.[12] To achieve these goals, primary stability higher than 35N.cm[14] or an Implant Stability Quotient (ISQ) above 70 is necessary.[15–17] Nonetheless, sometimes these requirements are not met, making immediate loading of the implant inadvisable, so that a more conservative approach, such as delayed loading is necessary.[14,16]

However, immediate loading is not a common procedure in the posterior area, since esthetics do not always play a crucial role. In general, the masticatory forces in the posterior area discourage many clinicians from conducting immediate prosthetic loading[18] as these forces are capable of preventing osseointegration of the implant during the healing phase.[6] Therefore, even if a high primary stability were to be achieved in the posterior area, a two-stage surgical protocol has traditionally been recommended.[19,20]

In both anterior and posterior scenarios, tissue remodeling is expected and the need for a second stage to recreate the soft tissue contours would be mandatory after osseointegration. Nonetheless, customized healing abutments can be used in such cases, protecting and containing the bone substitute during healing,[21] preserving the alveolar contour, and eliminating the need for a second reopening surgery and provisional restorations. By means of this technique,

critical and subcritical contours can be projected,[22] speeding up the peri-implant soft tissue conditioning phase in order to achieve final natural-like restorations.

Recently, customized healing abutments made of polyester-ether-ketone (PEEK) have been used for this purpose. Their polymeric composition, among other properties, such as no-metallic color, low weight, and high strength could be interesting for implementing this approach.[23] Similar approaches have been proposed for healed ridges using CAD/CAM technologies.[24–26] Another approach has suggested the use of a prefabricated matrix for immediate or delayed implant placements, however, this involves previous laboratory steps.[27] In addition, the studies cited above did not present the use of this technique in the esthetic area. Thus, the present article, by means of a sequence of clinical cases, aims to provide a detailed description of a simplified chairside approach to creating custom healing abutments made of polyester-ether-ketone (PEEK) for immediate implants placed after tooth extraction in both the anterior and posterior areas with the purpose of maintaining the soft tissue contours in addition to reducing the number of clinical steps.

Presentation of Cases

A schematic diagram of the clinical technique used to perform the following cases is represented in Figure 1.

Description of Case 1 – Anterior Area

The patient, a 56-year-old woman, sought dental care due to concern about the mobility of her maxillary left lateral incisor. During the clinical examination, soft tissue inflammation and tooth mobility were observed. Cone beam computed tomography (CBCT) showed evidence of a transverse tooth fracture at the infra-bone level. Furthermore, the 3D images showed apical bone height that would allow an implant to be placed immediately after tooth extraction (Fig 2).

Minimally invasive tooth extraction was performed with the use of a periotome (Maximus Instrumentais, Brazil) (Fig 3). After curettage of the tooth socket and profuse irrigation, a morse taper frictional implant (3.3 x 13 mm, Arcsys, FGM, Brazil) was inserted immediately. The implant insertion torque was 25 N.cm. As a low primary stability for immediate provisional restoration was achieved, it was decided to perform an immediate customized healing abutment. Firstly, the gap between the facial bone and the implant was filled with a synthetic bone substitute (Nanosynt, FGM, Brazil) (Fig 4).

A prefabricated healing abutment made of polyether-ether-ketone (PEEK) (Multifunctional healing abutment, FGM, Brazil) was roughened with diamond burs and placed in position. Flowable resin (Filtek Z350 XT Flow, 3M Espe, USA) was applied around the healing abutment in small amounts and light-cured, in order to prevent invasion of the tooth socket until the extracted tooth contour was completed (Fig 5). On completion of this step, the healing abutment was removed and critical and subcritical contours were also created with flowable resin. Finishing and polishing was then performed and the customized healing abutment was maintained in 0.12% chlorhexidine until it was placed over the implant (Fig 6). An immediate provisional restoration was adhesively bonded to

the adjacent teeth, without coming into any contact with the customized healing abutment during healing.

Four months later, the customized healing abutment was removed and a definitive frictional abutment for screw-retained restorations (Arcsys Foldable abutment, FGM, Brazil) was inserted. A provisional prosthesis copying the maintained emergence profile was placed until soft tissue maturation and then the final contour was transferred with a custom impression transfer. A final screw retained metal-ceramic restoration simulating the natural tooth emergence was inserted (Figs 7-9).

Description of Case 2 – Posterior Area

The patient, a 42-year-old woman presented with a jeopardized maxillary right first molar. After the clinical session and CBCT, extensive nonrestorable decay was diagnosed, compromising the furcation area. However, there was evidence of sufficient bone available for immediate implant placement after tooth extraction (Fig 10).

After this, following the same protocol as that previously described, a morse taper frictional implant (3.8 x 11 mm, Arcsys, FGM, Brazil) was inserted in the bone septum, achieving high primary stability (insertion torque of 50 N.cm). A synthetic bone substitute (Nanosynt, FGM, Brazil) was placed around the implant to fill the remaining socket. A prefabricated healing abutment of PEEK was customized as described before, and placed in position until complete healing occurred (Fig 11).

Four months later, the customized healing abutment was removed and a frictional abutment for screw-retained restorations was inserted. A transfer impression was

performed and a customized protection cap was placed in position during the laboratory phase to maintain the soft tissues contour. Finally, a screw retained metal-ceramic restoration was delivered, thus obtaining a natural emergence profile (Fig 12).

Description of Case 3 – Posterior Area

The patient, a 22 year-old man presented with the main complaint of continuous pain in the mandible caused by a fracture of the mandibular right first molar. The CBCT confirmed the fracture as well as an infectious process compromising the apical area of the molar. In addition, sufficient bone volume was observed beyond the socket, allowing immediate implant placement to be performed (Fig 13).

A minimally invasive tooth extraction was performed. However, the papillae were slightly released at this stage. A morse taper frictional implant (3.8 x 11 mm, Arcsys, FGM, Brazil) was inserted, achieving an insertion torque of 45 N.cm. As was done in the clinical cases reported above, the socket was filled with bone substitute, and the customized healing was made by copying the contour of the extracted molar. Two simple suture stitches were performed for the purpose of repositioning the displaced papillae (Fig 14).

After 4 months, a frictional abutment for screw-retained prostheses was inserted. As described in the previous case, a transfer impression was taken and a customized protection cap was placed during the laboratory phase. A final screw retained metal-ceramic restoration was delivered (Fig 15).

DISCUSSION

The proposed technique using a customized healing abutment aimed to present an alternative treatment to avoid a second surgical stage to expose the implant, while maintaining the natural contour of soft tissues. Conventionally, after the time taken for osseointegration, a second surgery is necessary to start the prosthetic stage of the treatment, by exposing the implant platform and inserting the healing abutment.[14,16]

An ideal healing abutment should allow tissues to maintain natural contours, respecting their volume and shape.[25] However, when using conventional prefabricated healing abutments, the surrounding soft tissues may be unfavorable to receiving the final restorations.[28] Knowing that an appropriate emergence profile of an implant-supported restoration is important for optimizing hygiene and esthetics, it is fundamental to obtain the conformation of a harmonious soft-tissue architecture around dental implants prior the final impression.[24,28–30] In order to achieve this goal, gradual modifications by means of provisional restorations are usually needed, which demands a larger number of appointments and a longer chairside time.[28]

During soft tissue healing, the organization of collagen fibers (after 4 weeks) and mature mucosal adhesion (after 6 to 8 weeks) are suggested.[7] Hence, the immediate insertion of a customized healing abutment in the first surgery would be helpful to guide the soft tissue biology, avoiding the occurrence of another local injury and extra time for soft tissue healing. Cellular adhesion to customized healing abutments may support the peri-implant mucosa and maintain its architecture.[21] Moreover, this device is capable of protecting and containing any bone substitute that fills the gap beneath it,[21] avoiding a more

invasive procedure to obtain primary wound closure.[31] The use of this technique does not avoid the need to use a bone substitute with a slow resorption rate, or if needed, a connective tissue graft, in order to guarantee esthetic results over the course of time.[10]

Although immediate loading is still a controversial issue, an overall analysis confirmed that implant failure rates of immediate loaded implants were no lower when compared with those of non-immediately loaded implants.[32] Although the predictability seems to be more risky in the posterior area, a recent systematic review showed no statistically differences between immediate and conventional loaded single implants in the posterior mandible.[18] Immediate loading, in addition to allowing a faster treatment, would favor the maintenance of the soft tissue architecture.[12,13] However, to accomplish this objective, high primary stability would be mandatory, thus the proposed approach with the use of a customizable healing abutment would be an alternative to support and guide the soft tissue healing even when the desired high primary stability could not be achieved. Due to the lack of references regarding the minimum primary stability required for using this device, the authors recommend a torque of at least 25 N.cm, without dismissing its use with higher torques.

Different authors have related similar approaches[27] even when using CAD/CAM[24–26] to achieve some of the aforementioned advantages, however, a simpler and more practical analog approach was presented in this report, following some guidelines previously described by Clavijo and Carvalho.[33] In 2016, it was stated that customized healing abutments were restricted to the non-esthetic zone[25,26] nonetheless, the results related in the present report seemed

to be appropriate for the anterior region as well, when an optimal primary stability has not been achieved with immediate implants placed after tooth extraction.

Currently, PEEK is increasingly being used for different dental applications. Its properties support its use as a biomaterial for transitional abutments, prosthetic frameworks and healing abutments. However, one drawback of this material is its inert surface that leads to a poor bonding to dental materials.[23] In order to overcome this issue, the PEEK surface was roughened in the cases of this report to allow micromechanical retention and maintain the resin in position, which would be sufficient to allow stability and strength of the customized healing abutment. Although PEEK healing abutments were used for the cases described in this report, it is also possible to perform the technique by using metal cylinders for provisional restorations of different implant systems.

CONCLUSION

The use of customized healing abutments seemed to be an appropriate solution to support and maintain the soft tissue contours after immediate implant placement in both the anterior and posterior regions, simplifying the entire treatment. The decision to apply the proposed approach must be addressed by the aims of the case-individual, and by the clinical indications and limitations previously discussed.

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Figure Legends

Fig 1 Sequence representing the clinical use of the customized healing abutment. A. Immediate implant placed after tooth extraction. B. Prefabricated healing abutment in position and the gap filled with a bone substitute, application and light-curing of flowable resin until completing the soft tissue contour. C. The healing abutment is removed allowing the creation of critical and subcritical contours, then placed in position again. D. Healed soft and hard tissues around the dental implant and the customized healing abutment. E. Transfer impression of the definitive abutment. F. Final restoration in position following the emergence profile obtained.

FIGURE 2 Initial situation. Left: Soft tissue inflammation around the lateral incisor. Right: CBCT image showing the horizontal fracture at the infra-bone level.

FIGURE 3 Minimally invasive tooth extraction with the use of periotome. The coronal fragment was removed first to allow a clinical view of the root fragment.

FIGURE 4 Left: Implant inserted in a palatal position. Observe the gap towards buccal wall and integrity of the papillae. Right: Gap filled with a synthetic bone substitute.

FIGURE 5 PEEK prefabricated healing abutment in position. Light-cured flowable resin filled the soft tissue contour.

FIGURE 6 Left: PEEK healing abutment roughened. Right: Customized healing abutment after finishing and polishing where critical (red) and subcritical (blue) contours were projected.

FIGURE 7 Left: Customized healing abutment inserted on the day of surgery. Right: Clinical view after 4 months of healing.

FIGURE 8 Soft tissues maintained around the customized healing abutment after four months.

FIGURE 9 Left: Frictional abutment for screw-retained restorations in position evidencing a proper emergence profile. Right: Final screw-retained prostheses inserted maintaining tooth contours after 12 months of clinical service.

FIGURE 10 Initial Situation. Left: Occlusal view showing a failed restoration in the maxillary right first molar. Right: CBCT image showing extensive, nonrestorable decay compromising the furcation area.

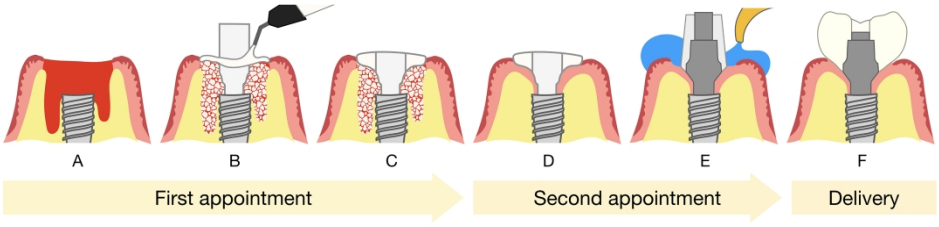
FIGURE 11 Implant insertion in the bone septum. Filling of the alveolus with bone substitute and customized healing abutment in position following the natural molar-shaped contour.

FIGURE 12 Left: Maintained soft tissue contours after four months of healing. Final abutment in position. Right: Metal-ceramic restoration inserted.

FIGURE 13 Initial Situation. Left: Fractured mandibular first molar. Right: CBCT showing sufficient bone beyond the alveolus.

FIGURE 14 Implant inserted. Socket filled with bone substitute and customized healing abutment in position.

FIGURE 15 Left: Fracture and extrusion of mandibular first molar. Right: Final restoration at 6-months follow-up.



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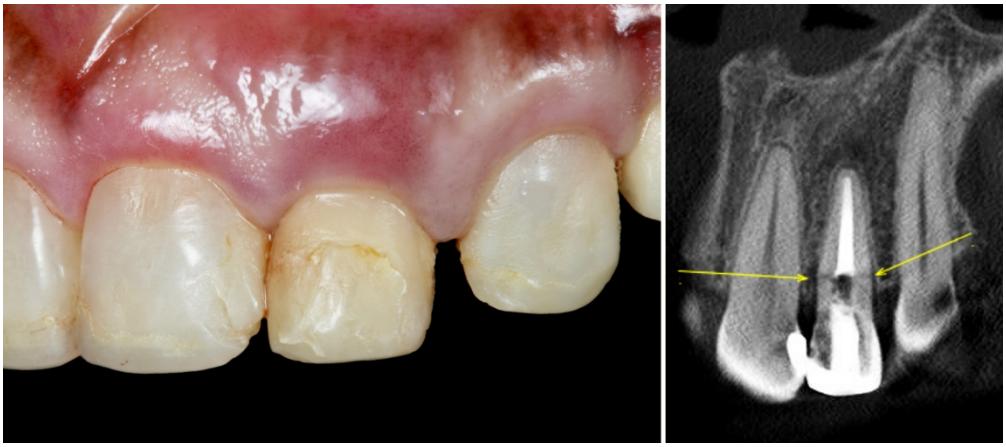

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2319x1017mm (72 x 72 DPI)

FIGURE 3 Minimally invasive tooth extraction with the use of periotome. The coronal fragment was removed first to allow a clinical view of the root fragment.

2958x1029mm (72 x 72 DPI)

FIGURE 4 Left: Implant inserted in a palatal position. Observe the gap towards buccal wall and integrity of the papillae. Right: Gap filled with a synthetic bone substitute.

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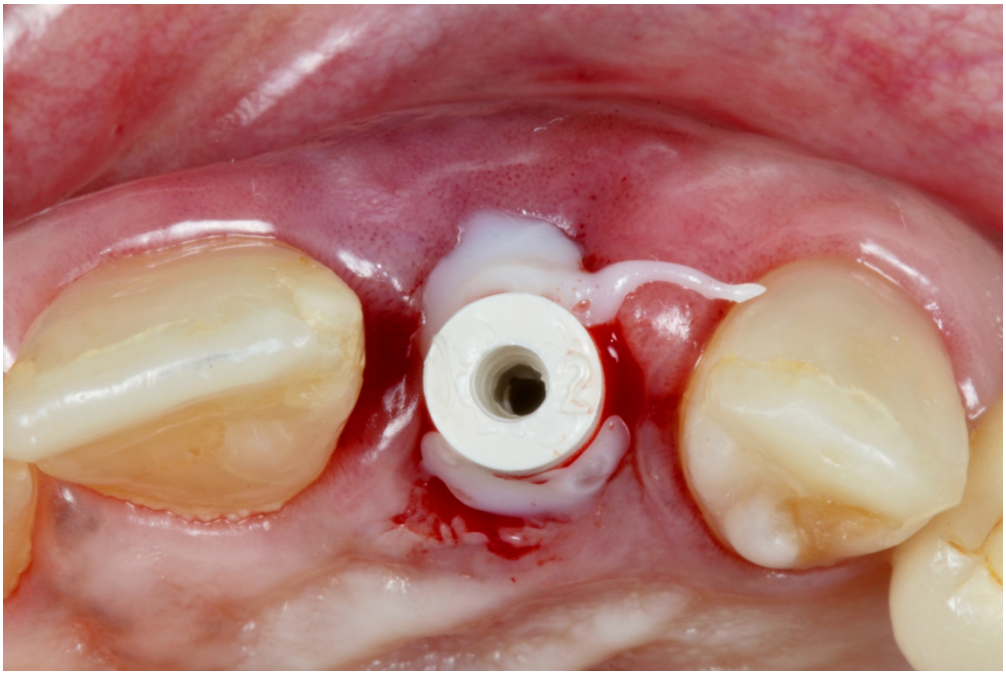

FIGURE 5 PEEK prefabricated healing abutment in position. Light-cured flowable resin filled the soft tissue contour.

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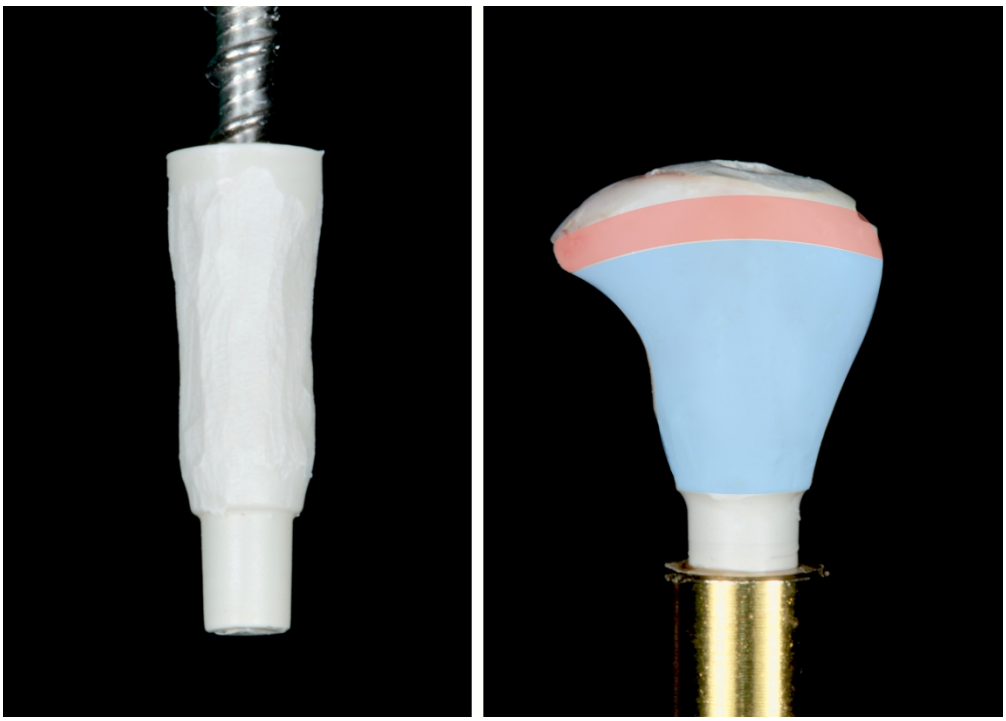

FIGURE 6 Left: PEEK healing abutment roughened. Right: Customized healing abutment after finishing and polishing where critical (red) and subcritical (blue) contours were projected.

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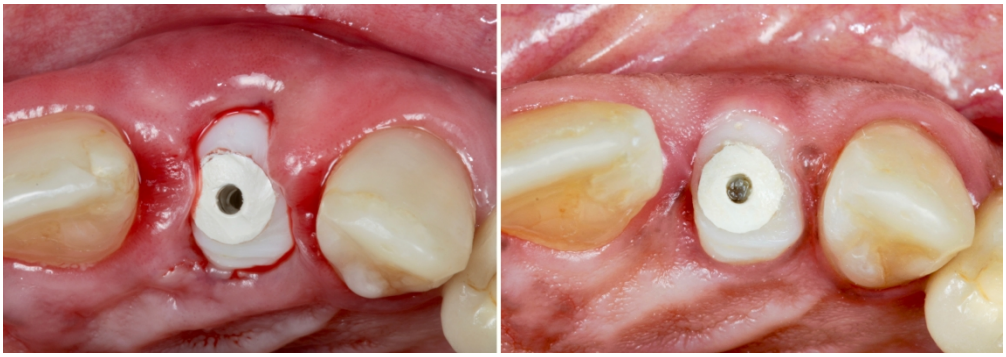

FIGURE 7 Left: Customized healing abutment inserted on the day of surgery. Right: Clinical view after 4 months of healing.

2958x1029mm (72 x 72 DPI)

FIGURE 8 Soft tissues maintained around the customized healing abutment after four months.

2490x1029mm (72 x 72 DPI)

FIGURE 9 Left: Frictional abutment for screw-retained restorations in position evidencing a proper emergence profile. Right: Final screw-retained prostheses inserted maintaining tooth contours after 12 months of clinical service.

2490x1029mm (72 x 72 DPI)

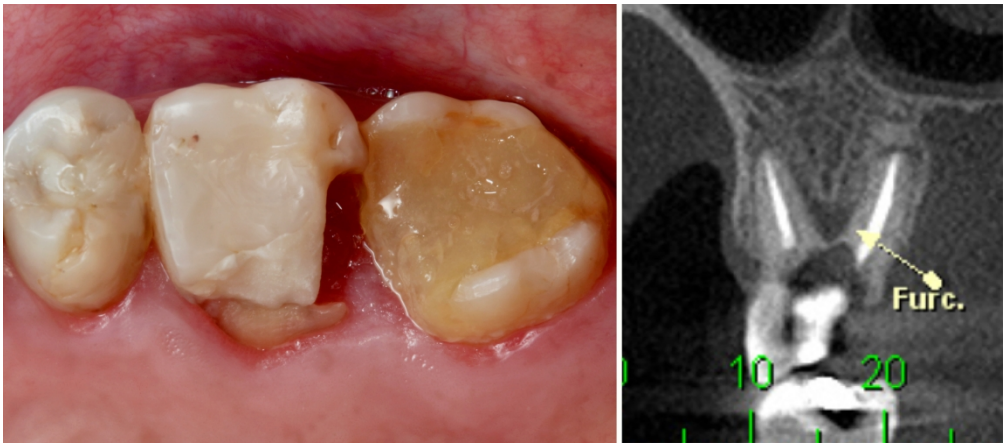

FIGURE 10 Initial Situation. Left: Occlusal view showing a failed restoration in the maxillary right first molar. Right: CBCT image showing extensive, nonrestorable decay compromising the furcation area.

2319x1017mm (72 x 72 DPI)

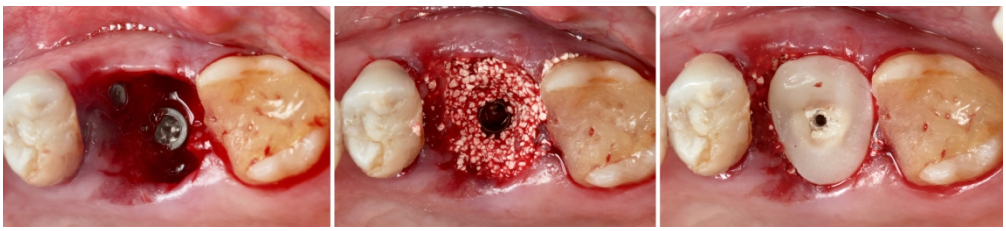

FIGURE 11 Implant insertion in the bone septum. Filling of the alveolus with bone substitute and customized healing abutment in position following the natural molar-shaped contour.

1999x442mm (72 x 72 DPI)

FIGURE 12 Left: Maintained soft tissue contours after four months of healing. Final abutment in position. Right: Metal-ceramic restoration inserted.

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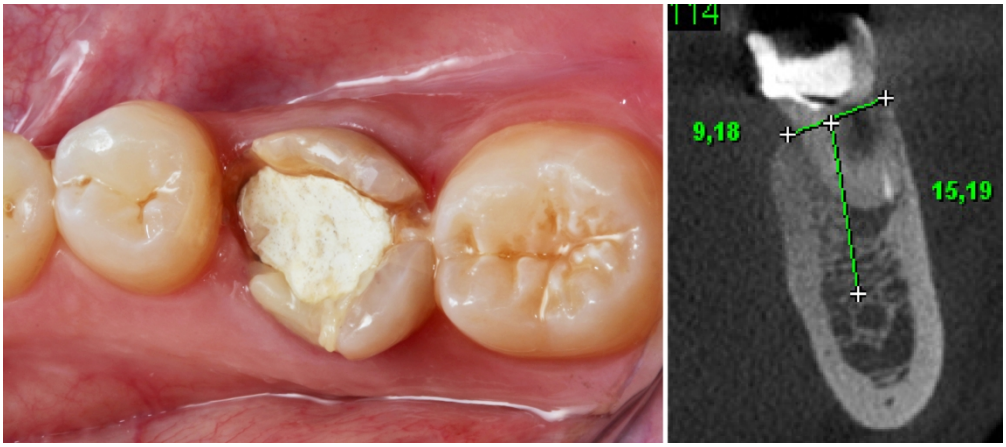

FIGURE 13 Initial Situation. Left: Fractured mandibular first molar. Right: CBCT showing sufficient bone beyond the alveolus.

2319x1017mm (72 x 72 DPI)

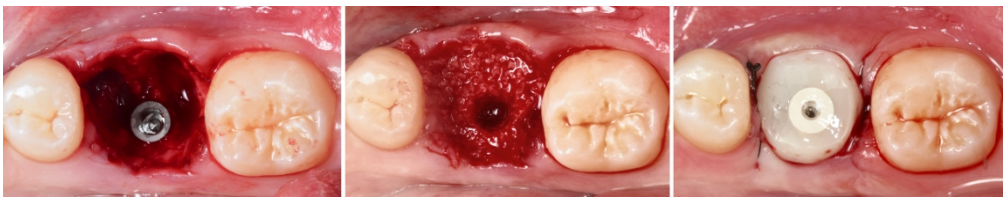

FIGURE 14 Implant inserted. Socket filled with bone substitute and customized healing abutment in position.

1999x380mm (72 x 72 DPI)

FIGURE 15 Left: Fracture and extrusion of mandibular first molar. Right: Final restoration at 6-months follow-up.

1500x497mm (72 x 72 DPI)